Volcanic Rocks from the Ross Island, Marguerite Bay and Mt. Weaver Areas, Antarctica

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Abstract: During the last several years volcanic rocks from the Ross Island, Marguerite Bay, and Mt. Weaver areas have been studied. Field data and some laboratory work indicate that the portions of the Ross Island area already studied consist of an older olivine basalt-trachyte sequence and a younger olivine basalt-basalt sequence. A K/Ar date determined from anorthoclase indicates an age of 0.68 ($\pm$0.14) m. y. for the Antarctic kenyte of the Cape Royds area. Chemical, isotopic, and petrographic analyses of the rocks from the Ross Island area continue. Future investigations will be concerned with the geology of the high peaks and the character of the volcanic activity and products of Mt. Erebus.

The Terra Firma volcanic rocks occur in the Marguerite Bay area and in other parts of the Antarctic Peninsula. They constitute a unit that may be a few thousand or more feet thick (NICHOLS, 1955) and consist, primarily, of andesite, dacite and rhyolite. Tuffs, breccias, and agglomerates are also common. The rocks may be Mesozoic or Cenozoic in age.

In the Mt. Weaver area volcanic rocks occur on the flanks of Mt. Saltonstall and constitute Mt. Early, which is apparently a partially dissected cone (DOUMANI and MINSHEW, 1965). Mt. Saltonstall consists of olivine basalt, basalt, tuff, and volcanic breccia.

Introduction

During the past several years volcanic rocks from the Ross Island, Marguerite Bay and Mt. Weaver areas (Fig. 1) have been studied. The Ross Island area was investigated during the 1964–65 austral summer and during short stays at McMurdo Station prior to that time. The portion of this paper that is concerned with the Ross Island area is really a progress report, as much remains to be done. Future investigations will be concerned primarily with the geology of the higher peaks of the area and the character of the volcanic activity and products of Mt. Erebus.

The volcanic rocks from the Marguerite Bay area were collected by Dr. ROBERT L. NICHOLS, a geologist with the Ronne Antarctic Research Expedition of 1946–48. NICHOLS (1955) has described the bedrock geology of this area. The portion of this report that deals with the Marguerite Bay area is concerned primarily with the petrography of the volcanic rocks.

The volcanic rocks from the Mt. Weaver area were collected by Mr. GEORGE

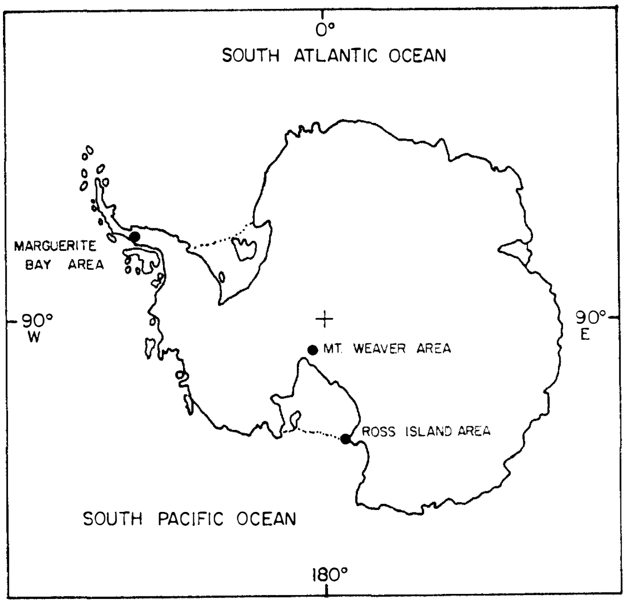

Fig. 1. Index map showing the location of the Ross Island, Marguerite Bay areas, Antarctica.

DOUMANI and Mr. VELON MINSHEW as part of a general investigation of the Mt. Weaver area during the 1962–63 field season. DOUMANI and MINSHEW (1965) have reported on the general geology. The portion of this report that deals with the volcanic rocks from the Mt. Weaver area is concerned primarily with the petrography of the volcanic rocks.

Ross Island Area

The Ross Island area (Fig. 1) is located in the Ross Sea sector of Antarctica near the edge of the Ross Ice Shelf. As here defined, it includes the volcanic rocks within an area bounded by Minna Bluff to the south, the Dailey Islands to the west, Cape Crozier to the east, and Cape Bird to the north and covers an area of approximately two degrees of latitude (79° to 77° S) and six degrees of longitude (170° to 164° E). Ross Island occurs approximately in the center of the area (Fig. 2). Volcanic rocks are discontinuously exposed along the coast line of the island and around the summit craters of Mt. Erebus, Mt. Terra Nova, Mt. Terror, and Mt. Bird. Mt. Erebus is approximately 4000 meters high and is probably still the only active volcano in the Antarctic; Mt. Terra Nova is approximately 2150 meters high; Mt. Terror is approximately 3270 meters high; and Mt. Bird is approximately 1770 meters high. These peaks, especially the higher ones, stand impressively over their rather bulbous bases and their flanks are dotted with trachytic plugs and basaltic cones.

Thus far, work has been done primarily on the coastal exposures of Ross Island and on some of nearby volcanic islands. During one field season and a portion of another the geology of Cape Bird, Cape Royds, Cape Evans, Inaccessible Island, the Dellbridge Islands, Tent Island, Little and Big Razorback Islands, Tryggve Point, Turks Head, the Dailey Islands, White Island, Black Island, Brown Peninsula, Minna Bluff and Cape Crozier has been investigated completely or in part in the field. Field data collected at these localities are summarized in the following paragraphs.

At Cape Bird an older sequence of olivine basalt-basalt and basalt porphyry-hornblende basalt-trachyte and a younger sequence of olivine basalt-basalt occur. A rudely-bedded palagonite tuff occurs near the shore line and at elevations as high as ten meters above the present shore.

On the higher slopes fragments of shells and fossiliferous volcanic breccia and conglomerate occur. The shell fragments were apparently derived from animals similar to those that still live in the Ross Sea. The shells and fossiliferous rocks are apparently contained in a till that underlies the ice immediately above the middle-penguin-rookery.

Cape Royds consists primarily of rather thin flows of what has been provisionally called Antarctic kenyte by SMITH (1955, p. 42) and TREVES (1962, p. 44). These flows are younger than the basalt at Cape Barne and, on the higher slopes of Mt. Erebus, are apparently overlain by a thin flow of olivine basalt. Breccias and conglomerates are rather common in this area.

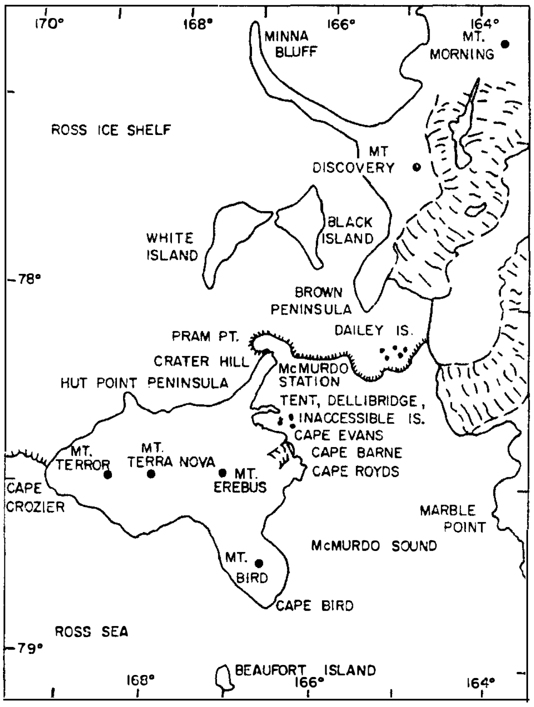

Fig. 2. Sketch map of the Ross Island area showing the localities of the various geographic areas studied.

A new analysis of the anorthoclase phenocrysts of the Antarctic kenyte from Cape Royds (Table 1) indicates that the composition is $Or_{15.9}$ $Ab_{63.4}$ $An_{20.7}$. The results (Table 1) are somewhat similar to those of Mountain (1925), who identified this feldspar as potash-oligoclase.

Table 1. Chemical analyses of anorthoclase.

		1	2	3
SiO_2		62.79	62.49	59.44
TiO_2		—	—	0.42
Al_2O_3		22.12	21.86	23.15
Fe_2O_3		0.36	0.30	0.60
FeO		0.41	1.31	0.77
MgO		—	0.16	0.43
MnO		—	—	0.05
CaO		3.76	3.74	4.42
Na_2O		7.35	7.20	7.44
K_2O		2.98	3.26	2.81
H_2O+		0.19	0.04	0.03
H_2O-		0.07	—	—
P_2O_5		—	—	0.17
	Or−	17.0	18.6	15.9
Mol. %	Ab	63.5	62.4	63.4
	An	19.5	19.0	20.7

1. Anorthoclase, Mt. Erebus, Antarctica ; Mountain (1925).
2. Anorthoclase, Mt. Erebus, Antarctica ; Mountain (1925).
3. Anorthoclase, Cape Royds, Antarctica ; this paper.

A specimen of the youngest, Antarctic kenyte flow exposed at Cape Royds was submitted to Geochron Laboratories for radiometric analysis. The K/Ar date determined from the anorthoclase phenocrysts is 0.68 ($\pm$0.14) m. y., which indicates that this rock is about Middle Pleistocene in age (Kulp, 1961).

Cape Evans consists of two (?) Antarctic kenyte flows that are similar to those exposed at Cape Royds.

Inaccessible Island consists of basalt and basalt porphyry. The lower and middle slopes of the island consist of from five to seven basalt flows. The summit of the island and upper slopes consist of basalt porphyry. All units dip to the north at about 20 degrees. The island is probably a remnant of a large cone.

The Dellbridge Islands were not visited. A helicopter reconnaisance of the area indicates that the islands consist of from three to four basaltic (?) flows that dip gently to the north and that they are probably part of the same structure of which Inaccessible Island is a part.

Tent Island consists of at least four flows of basalt porphyry and a thick volcanic breccia that constitutes the middle slopes of the island. A thin layer of vitric tuff occurs locally on the higher parts of the island.

Little and Big Razorback Islands consist of from four to five flows of basalt porphyry that dip gently to the north.

Tryggve Point and Turks Head consist primarily of rudely-bedded, volcanic breccia and lithic tuff that have been intruded by dikes and sill-like bodies of basalt prophyry.

The Dailey Islands are remnants of one or more volcanic cones and consist primarily of thin flows of olivine basalt and basalt.

White Island and Black Island have only been investigated in part. The field data indicate that they consist of an older sequence of volcanic rocks, olivine basalt-basalt-trachyte, and a younger sequence of olivine basalt-basalt.

Brown Peninsula has also only been investigated in part. The sequence is similar to that of Black and White Islands. The older rocks constitute a sequence of olivine basalt-basalt-trachyte ; a younger sequence consists of olivine basalt and basalt.

Only parts of Minna Bluff have been visited. Trachyte, basalt, and olivine basalt occur there and locally, at least, the flows dip gently to the north. Near Minna Saddle a thick sequence of cross-bedded, volcanic conglomerate and tuff occurs.

At Cape Crozier field data indicate that the sequence is olivine basalt-basalt-trachyte, the older sequence of other areas, and olivine basalt-basalt, the younger sequence of other areas. In addition, a rudely to well-bedded sequence of vitric and lithic tuffs and volcanic conglomerate occur on the coast at Cape Crozier. They were noted at heights of at least 12 meters above the present shore line.

In summary then, all field data indicate that the coastal portions of Ross Island and many of the smaller islands and other localities in the Ross Island area consist of an older sequence of olivine basalt-basalt-trachyte and a younger sequence that consists of olivine basalt-basalt. Preliminary investigation of the rocks in thin section and some chemical analyses tend, in general, to confirm these observations. The petrographic studies, however, indicate that the rock types are much more varied that the field data indicated. Olivine basalt, basalt, basalt porphyry, hornblende basalt, basanite, limburgite (?), olivine latite, latite, trachyte, and phonolite have thus far been identified in thin section.

All of the data thus far collected indicate that the rocks of the Ross Island Area are members of an alkaline olivine basalt-trachyte association. It is hoped that further work will contribute to a better understanding of the geological history of the Ross Island area and perhaps to our knowledge of the cause of volcanism in this area and its tectonic control. In this respect, it should be noted that some generalizations and suggestions have already been made. HAMILTON (1964, p. 677) indicated that the volcanic rocks of the Ross Sea area are part of a Cenozoic Volcanic Province of Antarctica. HARRINGTON (1965) noted that volcanic rocks of this association occur at Franklin Island, on the Hallet Coast, at

Mt. Melbourne, and in the Balleny Islands and that these volcanic "lines" along with the centers of volcanism in the Ross Island area may, in a broad way, be regarded as segments of a McMurdo Volcanic Arc.

Marguerite Bay Area

Marguerite Bay (Fig. 1) is located on the west side of the Antactic Peninsula (formerly referred to as the Palmer Peninsula or Graham Land). It is bounded on the north by Adelaide Island, on the east by the Fallieres Coast, on the south by King George VI Sound, and on the southwest by Alexander I Island. The area investigated by NICHOLS (1955) covers approximately one degree of latitude (69° to 68° S) and two degrees of longitude (68° to 66° W).

The Antarctic Peninsula is probably stratigraphically, structurally, and tectonically related to the Andean belt of Patagonia. The peninsula and Andean fold-mountain belt are connected by the Scotia Arc, which is a typical, volcanic island arc that is volcanically and seismically active.

The Precambrian and early Paleozoic histories of the peninsula are imperfectly known. ADIE (1962) has suggested that an igneous-metamorphic complex consisting of gneiss, schist and amphibolite is Precambrian in age and, further that associated volcanic and intrusive rocks are Cambrian in age. The late Paleozoic record is somewhat better known, as at this time the Antarctic Peninsula area was probably part of the great Andean geosyncline. The Trinity Peninsula Series, a thick, marine, clastic sequence of Carboniferous (?) age (ADIE, 1962), records this period of late Paleozoic sedimentation. A major, pre-Jurassic orogeny terminated sedimentation, in part, and was responsible for deforming and slightly metamorphosing the older rocks.

Mesozoic rocks are abundant in the peninsula area. Richly fossiliferous Middle Jurassic lacustrine beds occur in the Hope Bay area; slightly younger tuffaceous and fossiliferous marine units occur on Alexander Island; and Late Jurassic volcanic rocks are probably extensive. During the Cretaceous (HALPERN, 1964) marine, geosynclinal sediment accumulated in the peninsula area. Sedimentation was terminated in Late Cretaceous time when the Andean intrusive suite was emplaced.

Throughout the Cenozoic, sediment accumulated in restricted marine and non-marine environments. In various parts of the peninsula, lavas and pyroclastic rocks were deposited. Similar volcanic activity has occurred within historic time on some adjacent islands and in the Scotia Arc area.

Volcanic rocks in the Marguerite Bay area, named the Terra Firma Volcanics by NICHOLS (1948 and 1955) for rocks exposed on the Terra Firma Islands, occur on the Terra Firma Islands and Mushroom Island and at Black Thumb Mountain and Neny Fiord Thumb (Fig. 3).

The Terra Firma Islands are composed mainly of black, porphyritic, felsitic rocks and black tuff and lesser amounts of pyroclastic breccia (NICHOLS, 1955). The breccias contain angular fragments of granite, granitic gneiss, aplite, gabbro, felsitic volcanic rocks, and rhyolite. NICHOLS (1955, p. 53) suggests that the sequence of volcanic rocks must be hundreds of feet thick.

Mushroom Island consists mainly of grey, green and black, felsitic volcanic rocks and minor amounts of volcanic conglomerate. The volcanic rocks are closely jointed; some are porphyritic and some exhibit flow layering. NICHOLS (1955, p. 8) suggests that the felsitic rocks are flows or possibly shallow intrusives.

Black Thumb Mountain is composed mainly of grey and black, felsitic volcanic rocks and lesser amount of tuff, breccia volcanic conglomerate, and agglomerate. The fragmental rocks contain angular and subrounded fragments of volcanic rocks and coarse-grained granite or granodiorite. NICHOLS (1955, p. 54) notes that the volcanic rocks of Black Thumb Mountain are mainly horizontal

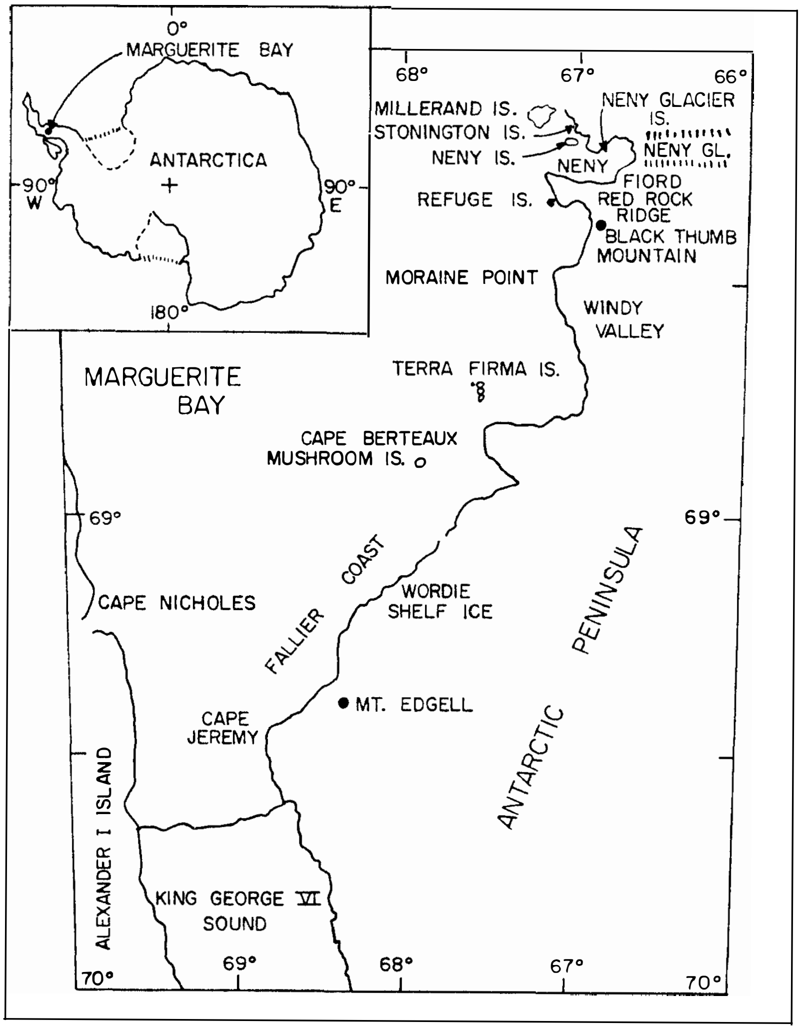

Fig. 3. Index map showing localities in the Marguerite Bay area.

flows that are probably a few thousand feet thick.

Neny Fiord Thumb consists primarily of brown, black, or grey, fine-grained volcanic rocks; black, grey, or white, massive, fine-grained volcanic rocks; and a volcanic breccia. NICHOLS (1955, p. 31) suggests that the volcanic rocks are flows and that the sequence is at least hundreds of feet thick and may be as much as 2000 feet thick.

Approximately one hundred specimens of the Terra Firma volcanics have been studied in hand-specimen and thin section. The study indicates that most of the volcanic rocks are andesites or andesite porphyry that consist primarily of andesine phenocrysts and microlites set in a fine-grained matrix that now consists of chlorite, epidote, and calcite. Less than five percent of the collection are basalt or basalt porphyry that consist primarily of labrodorite and augite. Approximately five percent of the rocks are rhyolites that consist primarily of quartz, sanidine, and oligoclase. Another five percent of the rocks are dacite that consists of quartz, andesine, and sanidine. Secondary chlorite, epidote, and calcite are present in the groundmass of almost every specimen of the Terra Firma Volcanics. Modal analyses of ten of the non-fragmental rocks of this group are presented in Table 2.

Table 2. Modal analyses of the Terra Firma Volcanics.

Mineralogy	1	2	3	4	5	6	7	8	9	10
Quartz	—	TR	—	TR	—	—	—	—	32.1	17.7
Plagioclase	49.8(30)*	69.2(30)	58.3(33)	58.2(31)	58.8(30)	67.8(53)	62.8(33)	50.1(55)	6.1(20)	66.3(32)
Sanidine	—	—	—	—	—	—	—	—	58.2	8.8
Augite	—	—	—	—	—	16.9	—	31.4	—	—
Chlorite	22.7	7.6	23.1	24.3	27.2	12.7	26.2	10.7	3.6	7.2
Epidote	15.0	17.4	18.1	9.7	8.4	—	8.7	4.3	—	—
Opaques	TR	TR	0.5	1.1	1.4	2.6	2.3	3.5	TR	TR
Calcite	12.4	5.8	—	6.7	4.2	—	—	—	—	—
Apatite	—	—	—	—	—	TR	—	TR	—	—

* Anorthite content.

1. Andesite ; Mushroom Island.
2. Andesite ; Mushroom Island.
3. Andesite porphyry ; Mushroom Island.
4. Andesite ; Terra Firma Islands.
5. Andesite ; Terra Firma Islands.
6. Basalt porphyry ; Terra Firma Islands.
7. Andesite ; Terra Firma Islands.
8. Basalt ; Terra Firma Islands.
9. Rhyolite ; Neny Fiord Thumb.
10. Dacite ; Neny Fiord Thumb.

The fragmental rocks are primarily andesitic volcanic breccias that consist of angular fragments of andesite and andesite porphyry and crystals and crystal fragments of andesine set in a matrix that has been altered to chlorite, epidote, and carbonate. Fragments of uralitic gabbro, diorite, quartz diorite, granodiorite, pink granite, and rhyolite occur in some of the breccias. Tuffs are not abundant in the collection. Those present are mainly andesitic, lithic tuffs. Modal analyses of the coarsest, pyroclastic rocks of the Terra Firma Volcanics are presented in Tables 3 and 4.

The Terra Firma Volcanics of the Marguerite Bay area constitute a group of rocks that are typical of the basalt-andesite-rhyolite association or the andesite-rhyolite kindred. As TURNER and VERHOOGEN (1960, p. 272) and others have noted, rocks of this kindred are typically developed in connection with moderate

Table 3. Composition of the pyroclastic rocks of the Terra Firma Volcanics.

Composition	1	2	3	4	5
Rock fragments	25 Granodiorite Andesite	45 Andesite Rhyolite Dacite Granodiorite	75 Andesite	25 Andesite Andesite porphyry	30 Andesite Andesite porphyry
Crystals	15 Quartz Oligoclase Microperthite	35 Quartz Oligoclase Biotite Microperthite	20 Andesine	15 Andesine	10 Andesine
Matrix	60 Chlorite Epidote Carbonate	20 Chlorite Epidote Andesine Carbonate	50 Andesine Quartz (?)	65 Chlorite Epidote	60 Chlorite Opaques

1. Volcanic breccia ; Black Thumb Mountain.
2. Volcanic breccia ; Black Thumb Mountain.
3. Andesitic volcanic breccia ; Mushroom Island.
4. Andesitic volcanic breccia ; Terra Firma Islands.
5. Andesitic volcanic breccia ; Terra Firma Islands.

Table 4. Composition of the pyroclastic rocks of the Terra Firma Volcanics.

Composition	1	2	3	4	5
Rock fragments	25 Andesite	50 Andesite	25 Andesite Andesite porphyry Granite Granodiorite	30 Andesite Andesite porphyry	55 Andesite Basalt
Crystals	15 Andesine	15 Andesine	10 Andesine	25 Andesine Microperthite Quartz	10 Andesine
Matrix	60 Andesine Chlorite Epidote Calcite Opaques	35 Andesine Chlorite Epidote Calcite Opaques	65 Andesine Chlorite Opaques	45 Chlorite Epidote	35 Andesine Chlorite Opaques

1. Andesitic volcanic breccia; Mushroom Island.
2. Andesitic volcanic breccia; Mushroom Island.
3. Andesitic volcanic breccia; Black Thumb Mountain.
4. Volcanic breccia; Black Thumb Mountain.
5. Volcanic breccia; Black Thumb Mountain.

to strong orogenic movements like those that have affected the margins of the Pacific through the later part of geologic time. They have been erupted everywhere along chains of active and recently active volcanoes that mark the fold arcs of the border of the Pacific.

NICHOLS (1955, p. 58) suggests that the Terra Firma Volcanics are post-Jurassic rocks and are probably late Mesozoic or early Cenozoic in age and, further, that they are younger than the gabbro-granite (Andean) suite of the Marguerite Bay area. ADIE (1955, p. 16) indicates that the gabbros of the Andean suite of rocks intrude the Terra Firma Volcanics and that the Upper Jurassic, Belemnite Point Beds are stratigraphic equivalents of the andesite-rhyolite volcanic group of the Antarctic Peninsula (ADIE, 1964, p. 310).

Mt. Weaver Area

The Mount Weaver area is located at about 87° S and 152° W (Fig. 4) near the head of the Robert Scott Glacier. As defined by DOUMANI and MINSHEW (1965) it includes Mt. Weaver, Mt. Wilbur, Mt. Howe, D'Angelo Gluff, Sunny Ridge, Mt. Early, Mt. Saltonstall, and Mt. Innes-Taylor. The basement consists of granitic rocks that are intrusive into a rather low-grade sequence of metamorphic rocks that consists of slate, phyllite, chlorite schist, and quartzite. Biotite from the granitic rocks at Mt. Wilbur has yielded a K/Ar date of 470 ± 14 m. y. (MINSHEW, 1965).

The basement rocks are nonconformably overlain by a thick sequence of sedimentary rocks that, locally, is about 700 meters thick and consists of intercalated conglomerates, sandstones, shale, and coal that contain *Glossopteris* leaves and fossil trees and a tillite (DOUMANI and MINSHEW, 1965). All of the older rocks have been intruded by diabase sills.

Volcanic rocks occur both north and south of Mt. Weaver, on the south flank of Mt. Saltonstall to the north and as a partially dissected cone, Mt. Early, south of Mt. Weaver. At Mt. Saltonstall the section is composed of at least nine horizontal flows of volcanic rock and is approximately 110 meters thick. The lowermost unit lies on the granitic rocks of the basement and is a 3.5 meter thick bed of agglomerate that has incorporated some of the granitic basement. The agglomerate is overlain by a grey basalt that is at least 32 meters thick. This thick flow is capped by a red and black scoriaceous unit that is at least 3.5 meters thick. The rest of the section consists of flows that range from 8 to 23 meters in thickness. Each flow is capped by and separated from overlying flows by a scoriaceous top. Ropy structures are common in the scoriaceous layers. At least two of the flows show megascopic concentrations of olivine near their bases.

Specimens collected from the flows range greenish grey to greenish black to black and weather to a reddish brown color. Those collected near the tops of the flows are strikingly vesicular, whereas those from near the base or center of the flows are massive. Many of the vesicular specimens show two sizes of vesicles. The average diameter of the larger vesicles ranges from 2 to 4 cm and they are commonly ellipsoidal. The smaller vesicles have average diameters that range

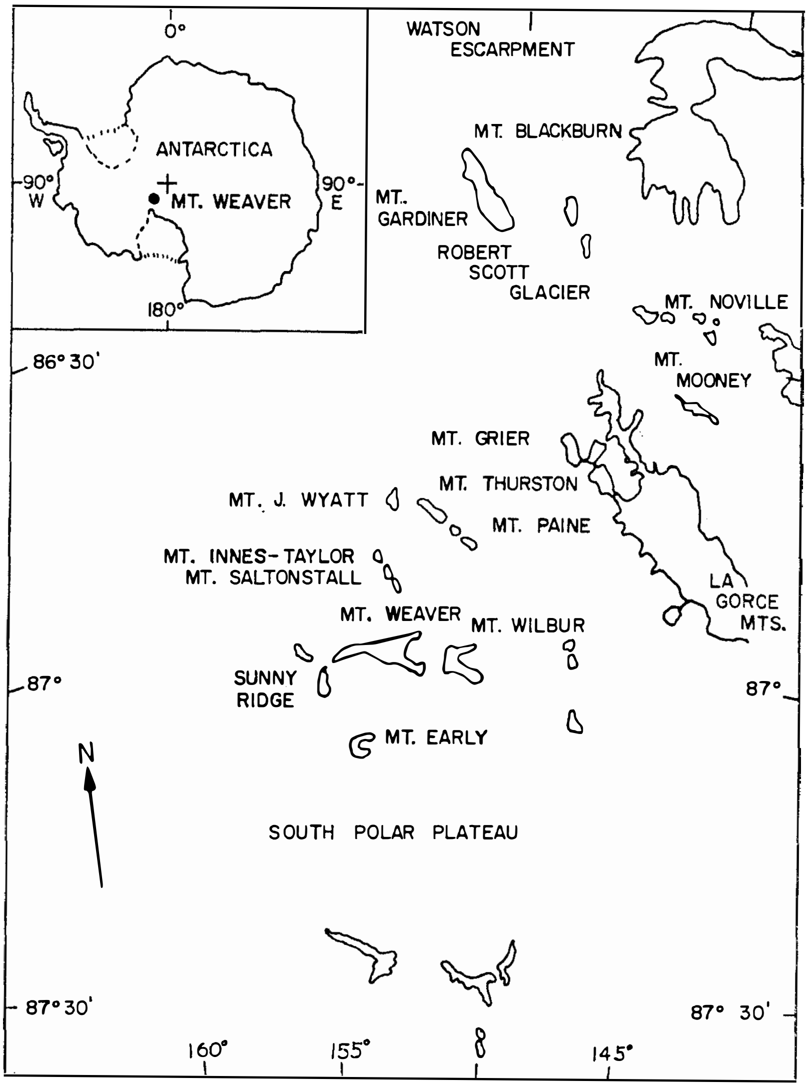

Fig. 4. Sketch map of the Mt. Weaver area.

from 2 to 5 mm and are usually spherical. All of the specimens show phenocrysts of plagioclase or olivine. A few are glomeroporphyritic. The scoria is either red or black and glassy. A few specimens of scoria exhibit megascopic phenocrysts of olivine and plagioclase. The basal, volcanic agglomerate consists of rounded fragments of black vesicular basalt with an average diameter of 4 cm set in a matrix of glassy, black scoria fragments with an average diameter of 5 mm. All of the fragments are cemented together by yellow-brown ash.

In thin section the basalts are diabasic in texture and range from fine to medium grained. The plagioclase is labradorite (An_{50} to An_{58}) and occurs as zoned phenocrysts and unzoned microlites. Microlites tend to be less calcic than the plagioclase phenocrysts. Olivine occurs as euhedral phenocrysts and as subhedral grains in the groundmass. Grain boundaries tend to be reddish brown. Hypersthene occurs mainly as phenocrysts. A minor amount, however, does occur in the groundmass of some specimens. Pigeonite occurs primarily in the groundmass as anhedral grains between plagioclase microlites. The opaque minerals occur as interstitial, anhedral grains in the groundmass. Apatite also occurs in the groundmass as euhedral to subhedral grains. Modal analyses of some of the typical basaltic rocks are presented in Table 5.

In thin section the volcanic agglomerate that occurs at the base of the section consists of rounded to angular fragments of glassy, vesicular scoria that is charged with plagioclase microlites and euhedral crystals of olivine. The borders of fragments and vesicles are palagonite. A few vesicles are lined with opal. The larger fragments are set in a matrix of fine fragments of the same material and glass shards that consist entirely of palagonite. A modal analysis and an analysis of the fragments are presented in Table 5.

Mt. Early is an extinct, partially dissected volcano that consists primarily of olivine basalt, tuff, and volcanic breccia. MINSHEW (field notes) tentatively identified an olivine basalt neck with columnar joints and some lahar deposits and noted that the at least two and possibly three tuff sequences occur, the thickest being about 170 meters thick.

The basalts from Mt. Early are black to greenish black to grey rocks. Almost all of the specimens are vesicular and most are porphyritic. A few are glomeroporphyritic. The phenocrysts are commonly plagioclase, olivine, and pyroxene.

Table 5. Modal analyses of scoria, vesicular basalt, massive basalt, and agglomerate from Mt. Saltonstall.

	1	2	3	4	
Plagioclase	22.1(50)*	58.9(53)	67.6(58)	Coarse fragments	12.3
Pigeonite	—	17.9	15.7	Fine fragments	78.2
Hypersthene	2.0	1.5	1.6	Ash	9.5
Olivine	3.2	13.4	12.8		
Glass	72.7	—	—	Mineralogy	
Opaques	—	2.3	2.3	Glass	81.7
Apatite	—	TR	TR	Plagioclase	6.2
				Olivine	4.3
				Palagonite	6.8
				Opal	TR

* Anorthite content.

1. Red scoria; Mt. Saltonstall.
2. Massive basalt; Mt. Saltonstall.
3. Vesicular olivine basalt; Mt. Saltonstall.
4. Volcanic agglomerate; Mt. Saltonstall.

Table 6. Chemical and modal analyses of basalt from Mt. Weaver area.

	1	2	
SiO_2	49.40	Mode	
TiO_2	2.26	Plagioclase	35.4
Al_2O_3	18.34	Augite	17.4
Fe_2O_3	0.72	Pigeonite	6.5
FeO	7.87	Olivine	1.2
MnO	0.15	Glass	37.2
CaO	9.28	Opaques	TR
Na_2O	3.59	Apatite	TR
K_2O	1.72		
H_2O+	0.50		
H_2O-	0.02		
P_2O_5	0.54		

1. Chemial analysis-basalt; Mt. Weaver area.
2. Modal analysis-basalt; Mt. Weaver area.

The tuffs and breccias from Mt. Early are commonly massive and consist of angular fragments of basalt, porphyritic basalt, and scoria set in a yellow-brown matrix of ash and crystals of olivine, plagioclase, and pyroxene.

In thin section the basalts are diabasic in texture and range from medium to fine grained. The plagioclase is labradorite (An_{50} to An_{60}) and occurs as phenocrysts and in the groundmass as microlites. Olivine also occurs as euhedral phenocrysts and as anhedral grains in the groundmass. Augite and hypersthene occur as phenocrysts and only rarely in the groundmass. The pyroxene of the groundmass is anhedral to subhedral pigeonite. Apatite and opaque minerals are common accessories and occur interstitially. A modal analysis and a chemical analysis of a specimen of basalt from Mt. Early are presented in Table 6. The glass of this rock is dark brown and is charged with opaque, dust-like particles.

The fragmental rocks of Mt. Early are volcanic breccias, lithic tuffs, composite tuffs, and lithic-vitric tuffs.

The volcanic rocks of the Mt. Weaver area are primarily olivine basalts that are associated with volcanic agglomerate, volcanic breccia, composite tuffs, vitric tuffs, vitric-lithic tuffs, and possibly lahar deposits. The age of these rocks and their relationships, if any, to other volcanic rocks of Antarctica is not known. DOUMANI and MINSHEW (1965, p. 139) suggest that the volcanic rocks may be Late Tertiary or Quaternary in age.

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